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Revision A

PROCESS CONTROLS SPECIFICATION
CHROMIUM TREATMENT FACILITY

Bureau of Corrective Actions
Special Branch Projects
Nevada Environmental Response Trust

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1.0 PURPOSE

This document is to provide a description of the control logic for the various systems and equipment that comprise the Chromium Treatment Facility. The document assumes the physical equipment is installed, commissioned and is ready for normal treatment service.

This document is not intended to be an operations manual as it only addresses the process logic and controls.

2.0 INTRODUCTION

Envirogen Technologies' designed the replacement treatment facility for treatment of water from the Interceptor Well Field. The treatment system is designed to reduce the concentration of chromium to meet the discharge criteria. After treatment at the chromium treatment facility, the water is pumped to GW-11, the FBR feed water equalization basin, or to the FBR Feed Tank, TK-101A.

Chromium Treatment: In the natural environment, chromium is found in different oxidation states. These oxidation states have been observed to show differences in toxicity, solubility and mobility. Hexavalent chromium [Cr (VI)] has high groundwater solubility, and will move along with the flow of groundwater. Hexavalent chromium (+6) is toxic to people.

The environmentally beneficial form of chromium is the immobile, nontoxic trivalent chromium. Reduction of hexavalent chromium to trivalent chromium usually involves the use of a reducing agent to react with the toxic Cr (VI) to nontoxic Cr (III) or less toxic ones. Hexavalent chromium reducing agents include sulphites, sodium dithionite, hydrogen peroxide, and ferrous ion compounds.

The selection of ferrous sulfate (a ferrous ion compound) for use in the chromium treatment facility has advantages not found in other reducing agents, because it suites the natural environmental process. Ferrous Sulfate effectively interacts with solid-phase and dissolved-phase Cr (VI), transforming it to Cr (III).

At the chromium treatment facility, the process monitors the delivery of ferrous sulfate. If the dosing of ferrous sulfate stops, the process is shutdown. When the flow of reagents is restored, the process is placed back on-line.

pH: Chromium solubility is a function of the groundwater pH. After the primary chromium treatment step, the process water pH is adjusted into the range where chromium is insoluble. With chromium in its insoluble state, the remaining treatment steps are associated with solids separation.

GENERAL PROCESS NOTES: The process logic includes two conditions which will shut down the process. When the process is treating water from the interceptor wells, the process logic continuously monitors ferrous sulfate dosing. The process logic will shut down the treatment system if ferrous sulfate dosing stops for any reason. The other condition where the treatment system is shut down is operator initiated. When any unsafe operation is observed, the process operator can take the treatment system off-line by pushing the "Process Stop" button (the red mushroom head push button).

Other than these two conditions where the process is shut down, the treatment process is designed to maximize on-line operations. This means that all alarms will suspend process operations to protect against un-safe operating conditions from occurring, provide an opportunity for the process to correct itself, and allow the treatment process to resume safe operations after the correction of conditions that would have led to unsafe operations. As a result, most alarm conditions are not latched in logic, and do not require the process operator to acknowledge or reset alarm conditions.

Most process pumps are configured with hand-off-auto switches and A-B selector switches. When the HOA is placed in Hand mode, the operator can check the pump rotation direction. The operator should rarely operate equipment in Hand Mode.
Most process pumps include on-line spares. P-1A/B, P-2A/B, P-3A/B, P-4A/B, P-5A/B, P-6A/B, P-8A/B, and P-9A/B are examples of pumps with on-line spares. The A – B selector switch is used to select the duty pump. Process pumps 7A/B/C, P-10A/B, and P-11 are provided with shelf spares.

All process switches configured from an analog signal will allow the process operator to choose the process set point. When a process switch is used to generate an alarm, the operator can select the time duration that the activated switch must remain active before the switch activates the alarm. This feature eliminates false alarms.

CONTROL PANEL OPERATING DEVICES: The face of the control panel is to include a panel power disconnect switch, a white lens power indicator, an emergency "Process Stop" button, and the operator interface terminal. A convenience power outlet and panel light are to be provided inside of the panel.

3.0 CHROMIUM TREATMENT FACILITY

3.1 Interceptor Well Field Pump Control

The process control system for the Chrome Treatment Facility includes an overall well pump run permissive. The run permissive of the interceptor well pumps is withdrawn when the level in the Equalization Tank T-1 rises to the high-high level set point. The HMI station also includes switch HS-IWF, which provides the means for the operator to withdraw or restore the interceptor well pump run permissive. This switch is primarily used during process start-up.

3.2 Equalization Tank

FLOW EQUALIZATION: Ground water from the Interceptor wells is fed to a 21,000 gallon Equalization Tank, T-1. Water from T-1 is pumped by the process feed pump, P-1A or P-1B.

DUTY PUMP: A selector switch, configured in the HMI, is used to select the P-1A/B duty pump. The PLC uses this selector switch to route both the pump on / off switch signal (digital) and the (analog) pump speed signal.

EQUALIZATION TANK LEVEL CONTROL: The process operator has a choice between two control modes for water being fed to the process. The operator can feed the treatment process using **FLOW CONTROL OR LEVEL CONTROL**. Flow control is selected by placing the SC-P1 controller's local / remote switch in the local mode. In this control mode, the process operator provides a set point to FC-1. FC-1 accepts the flow rate signal from an electromagnetic flow meter, and compares the process flow to the controller's set point. The controller output is then used as the P-1 frequency set point. When this process flow mode is selected, all downstream tank levels are operated on level control

The alternate process control mode places T-1 under **LEVEL CONTROL.** Level control is selected by placing the SC-1 controller's local / remote switch in the remote mode. The process operator inputs the LC-1 controller with a level set point and the level controller output signal is used as the P-1 frequency set point. When this process control mode is selected, the process feed rate will match the average feed rate entering T-1. The default control mode is level control.

OTHER T-1 CONTROL FEATURES: When the level in T-1 rises and activates LAHH-T1, the run permissive signal is withdrawn from each Interceptor well's pump. When the level in T-1 falls to the LAL-1 switch set point, the run permissive signal is restored to the Interceptor well pumps.

When the level in T-1 falls and activates LALL-1, the run permissive signal is withdrawn P-1A/B. When the level in T-1 rises to the set point for LAH-1, the run permissive signal is restored to P-1A/B.

PROCESS FEED RATE: The process feed rate, as measured by FI-1, is shared with the ferrous sulfate dosing pumps. The dosing algorithms are flow-paced with the FI-1 flow rate. The dosing algorithms are fully described later in this document.

3.3 Chemical Reaction Tank

The Chemical Reaction Tank T-2 is a 21,000-gallon tank with two internal baffles, making T-2 act as three separate tanks.
When the third chamber of T-2 is operated under level control, the level in the first two chambers of T-2 is set by the height of the overflow weir.

There are two recycle lines that are routed back to the third chamber of the Chemical Reaction Tank T-2. The sludge tank supernate line and the geotextile filtrate line, are the two recycle lines.

DUTY PUMP: A selector switch, configured in the HMI, is used to select the P-2A/B duty pump. The PLC uses this selector switch to route both the pump on / off switch signal (digital) and the speed set point signal (analog) to the selected pump's motor starter.

CHAMBER 1: Ferrous sulfate is added to the first chamber of the Chemical Reaction Tank T-2. Mixer, M-2A mixes the ferrous sulfate and water from the interceptor wells to initiate chromium reduction reactions. The first chamber of T-2 provides contact time for the ferrous sulfate to reduce chrome VI to chrome III.
CHAMBER 2: The pH of the feed water is increased in the second chamber of the Chemical Reaction Tank T-2. At pH of approximately 7.5 s.u. and higher, chrome becomes insoluble. After the Chemical Reaction Tank T-2, Chrome is no longer dissolved in the ground water, allowing chrome to be removed from the process by clarification and solids separation.

Both lime slurry and sodium hydroxide can be used to increase the pH of the ground water. Currently, sodium hydroxide is added to the second chamber of the Chemical Reaction Tank. Mixer M-2B is used to uniformly mix the sodium hydroxide into the groundwater stream.

Future testing may reveal that an increase in sodium hydroxide dosing in the second chamber of the Chemical Reaction Tank may allow a reduction in the amount of lime slurry needed to condition the sludge in the Sludge Tank (T-6) (later in the process).

CHAMBER 3: The third chamber of T-2 is used as a pump accumulator, which is needed to deliver a steady source of water to the suction of P-2A/B. A pH analyzer measures the pH of the water

leaving the second chamber, and adjusts the dose rate of sodium hydroxide to maintain the pH set point.

ADDITIONAL FEATURES OF THE CHEMICAL REACTION TANK: The first two chambers of the Chemical Reaction Tank T-2 include a mixer. Both mixers have a local on / off selector switch and a local mixer speed set point. HS-M2A is used to start / stop the mixer in Chamber 1, and HS-M2B is used to start / stop the mixer in Chamber 2. SC-M2A and SC-M2B are used to set their respective mixer rotating speed. The operating status of the mixers is monitored by the PLC.

CHAMBER 3 LEVEL CONTROL: Water is pumped from the third chamber of the Chemical Reaction Tank to the flash mix tank of the inclined plate separator. LC-2 measures the level in the third chamber of the Chemical Reaction Tank. The operator provides a LC-2 level set point. When the control mode of SC-P2 is set to remote, the LC-2 output signal is used as the speed set point for Pump SC-P2.

DUTY PUMP: A selector switch, configured in the HMI, is used to select the P-2A/B duty pump. The PLC uses this selector switch to route both the pump on / off switch signal (digital) and the speed set point signal (analog) to the selected pump's motor starter.

ADDITIONAL P-2 CONTROLS: The Clarifier Feed Pump P-2 uses a HOA switch HS-P2 to start / stop the pump. The P-2A/B run permissive is withdrawn when LAHH-T5 or LAHH-5 activates. The P-2 run permissive is restored when the level in the Effluent Tank falls below the set point for LSL-T5.

3.4 Flash Mix, Floc Tank, and Inclined Plate Separator

Water pumped from the third chamber of the Chemical Reaction Tank is pumped to the Flash Mix Tank of the Inclined Plate Separator.

FLASH MIX TANK T-3A: The clarifier reject stream, which normally flows to the Sludge Conditioning Tank, is directed (with FV-T6) to the Flash Mix Tank T-3A. The Clarifier Reject stream is used as Seed Sludge, which promotes agglomeration of the chrome particulates. Seed Sludge is added to the Flash Mix tank on frequency and duration timers. The timers do not increment when P-3A/B is not operating.

FLASH MIX TANK MIXER M-3A: To ensure that Seed Sludge is well mixed, Mixer M-3A is included. An On/Off switch, HS-3A, is used to energize / de-energize the mixer. A local indicator is used to confirm the mixer's operating status.

FLOC TANK T-3B: Process water flows over a weir to enter the Flocculation Tank T-3B. Polymer is added to the flocculation tank to bind the arsenic and iron precipitates into larger particle sizes. The

mixer speed is of primary importance. The mixer is needed to keep the particulates in suspension. If the mixer operates at a high speed, the mixing energy will break-up the flocculated particles. Variable frequency Floc Mixer M-3B, is used to keep the precipitates in suspension. M-3B is started and stopped with HS-3B. The mixer speed is set with SC-3B.

From the flocculation tank, the process water flows over a weir to enter into the inclined-plate Separator C-3. Solid/Liquid separation occurs, with the solids accumulating at the bottom of the clarifier, and clarified water flows over a weir into the clarifier's effluent chamber.

3.5 Solids Removal

Accumulated solids at the bottom of the clarifier leave the clarifier intermittently using frequency and duration timers. At the beginning of the time cycle, sludge pumps P-4A/B are placed into operation, removing solids from T-6 on an intermittent basis.

The clarifier reject stream is pumped, with the Separator Reject Pump P-4A/B, to one of three dewatering boxes, T-7A, T-7B, or T-7C. P-4A/B, are air operated double diaphragm pumps. Inside each dewatering box is a 100-micron geotextile fabric membrane that allow water to pass through the fabric and leave the solids inside.

The Separator Reject Pump feeds one geotextile membrane at a time. While this membrane is filling, the former on-line membrane drains. The third dewatering box, with a filled geotextile membrane, is covered with a canvas tarp, and trucked off-site for disposal. Once the filled membrane is disposed, the dewatering box is returned to the site, and a fresh geotextile fabric membrane is fitted into the dewatering box.

Filtered water from the membrane is pumped back to the third chamber of the chemical reaction tank with submersible pump P-7A, P7B, or P-7C. The filtrate (filtered water) returns back to the Equalization Tank to be retreated.

DEWATERING BOX CONTROLS: The Dewatering Box uses a constant speed pump P-7A / P-7B, or P-7C to return filtrate to the third chamber of the Chemical Reaction Tank using pump-down control. The sump pump is configured with two float switches, LSH and LSL. Interlocks 7A / 7B, or 7C will also remove the sump pump run permissive when LAHH-2 or LSHH-T2 activate. The P-7A, P7B, and P-7C run permissive is restored when the level in T-2 falls below the set point for LAL-2.

ADDITIONAL P-7 7A, P7B, and P-7C CONTROLS: The Filtrate Pump P-7A/B/C uses a HOA switch HS-T7A/B/C to start / stop the pump. When the LSH float switch activates, P-7A/B/C will start if the pump is in the Auto mode. When the LSL float switch activates, P-7A/B/C is turned off if the pump is operating in the auto mode.

3.6 Effluent Tank

Clarified water from C-3 flows by gravity to the Effluent Tank T-5. Effluent Holding Tank T-5 is used as the pump accumulation Tank for the Effluent Pumps P-5A/B. T-5 provides more than 28 minutes of hold-up.

DUTY PUMP: Selector switch HS-P5 is provided to select the P-5 duty pump. The PLC uses this selector switch to route both the pump on / off switch signal (digital) and the speed set point signal (analog) to the selected pump's motor starter.

EFFLUENT TANK CONTROLS: The effluent tank is equipped with a level transmitter (LT-5) and a redundant high-high level float switch (LSHH-T5). When the water level in T-5 rises and activates either LAH-T5 or LAHH-5, the run permissive signal for the clarifier feed pump P-2A/B is withdrawn. The run permissive signal for the clarifier feed pump P-2A/B is restored when the level in T-5 falls below the set point for LAL-5.

When the level in T-5 falls and activates LALL-1, the run permissive signal is withdrawn from P-5A/B. When the level in T-5 rises and activates LAH-1, the run permissive signal is restored to P-5A/B.

DISCHARGE POINT SELECTION: Water from the Effluent Tank can be discharged either to the GW-11 Pond, or to the Feed Tank TK-101. The position of Selector Switch HIC-11A (existing) is used to select the discharge point.

3.7 Chemical Dosing

The process feed flow meter FIT-1 is used to monitor the feed flow rate to the treatment system. FIT-1 has a local flow display and sends a corresponding analog signal to the PLC. The ferrous sulfate dosing system uses the process feed rate to flow pace the dosing rate to the process. Lime slurry and polymer are dosed when the upstream process pump is operating. The pH analyzer is used to measure the pH of process water in the third chamber of the Chemical Reaction Tank T-2. The operator provides a pH set point to the controller, and the amount of caustic is dosed by the pH controller's output signal.

3.7.1 Lime Slurry

LIME BASICS: Lime and water are mixed on-site to produce calcium hydroxide. When hydrating the lime, 1.93 gallons of water is needed to be mixed with 50 pounds of lime to satisfy the reaction:

$CaO + H_2O \rightarrow Ca(OH)_2 + Heat$

24,500 BTUs of heat is released for each 50 pound bag of lime that is hydrated. This amount of heat is sufficient to boil 3 gallons of water.

Using these facts, a 50 pound bag of lime should be mixed with excess water. Lime should be added to the Lime Slurry Tank T-8 slowly to ensure that all of the added lime is fully hydrated.

After preparing the lime slurry, the operator selects which lime slurry pump will be used to dose the process. The operator does this using selector switch HS-8. The local HOA switch HS-8A/B is used to select the hand or auto operation of the lime slurry dosing pump. When the lime slurry pump is placed in Auto, the PLC will operate the lime slurry pump when the clarifier reject pump is in operation.

The dosing rate of the Lime Slurry Pumps is set locally at the pump. The operator adjusts the pump speed set point knob to select the desired dosing rate.

The OIT display of the Lime Slurry Dosing system will include the Lime Slurry Tank Mixer run status, the run status for both dosing pumps, and the TAH-T8 alarm status.

The operator will be able to select the duty line Lime Slurry dosing pump through the OIT using the P-8A / 8B pump selector switch. The selected dosing pump will use the HAND/OFF/AUTO switch HS-P8. When P8 is operated in Auto, P-8 will operate when P-3 is in operation.

3.7.2 Ferrous Sulfate

The ferrous sulfate dosing system includes the ability to remotely operate P-12 (by others), the ferrous sulfate transfer pump. T-12 is the remote 10,000 gallon ferrous sulfate tank (by others). P-12 is used to pump from the remote 10,000 gallon ferrous sulfate storage tank to replenish the local ferrous sulfate tank T-9. The ferrous sulfate dosing system also includes the ferrous sulfate tank, the duty ferrous sulfate dosing pump, and an online spare dosing pump.

Ferrous sulfate is dosed to the Chemical Reaction Tank in proportion to the process feed rate. Ferrous sulfate is used to chemically reduce chrome VI to chrome III, which is dosed to the first chamber of the Chemical Reaction Tank T-2. The pump is controlled by a speed control signal from the PLC based on the feed flow signal and an adjustable proportionality

factor. Each pump shall have a HAND-OFF-AUTO selector switch with provisions to allow a manually set flow speed rate while in HAND mode and an adjustable proportionality factor in AUTO mode.

The OIT shall display the transfer pump P-12 Run Status, the ferrous sulfate tank T-9 level, the run status of the selected ferrous sulfate dosing pump, the ferrous sulfate dosing pump speed (0-100%), and the alarm status of FAL-9A and FAL-9B

For each pump, the OIT will include the HAND/OFF/AUTO switch (HS) for P-9A, P-9B, and P-12, the ferrous sulfate proportionality constant (K) for the Auto mode of SC-9, and Manual Speed inputs for hand Mode for SC-9.

During normal operations, the ferrous sulfate dosing pumps shall be placed in the AUTO mode with the PLC automatically dosing the ferrous sulfate to the first chamber of the chemical reaction tank T-2. In the following equation:

Pump Speed

P-9 A or B Pump Speed (0–100%) = K*(FI-1 gpm)/(60 gpm)*(D_f)

Where:

K = user set proportionality constant (0 to 2.00 range)

[P-9 A or B] D_f= Dose Factor

3.7.3 Polymer

The Chrome Treatment Facility includes two polymer systems, dosing polymers with different properties. One system will dose polymer to the Floc Tank T-3B and the other polymer system will dose polymer to the sludge line feeding the geotextile filters. The geotextile filters are fitted in the De-watering Boxes, T-7A, T-7B, and T-7C.

Both polymer systems pump activated polymer, to agglomerate suspended particles for easier settling.

Each polymer pump includes local settings to control the polymer dosing rate. Each polymer pump will be configured to accept PLC start / stop control. The P-10A polymer pump will operate when P-2A or B is running. P-10B polymer pump will operate when P-4A or B is running. The OIT will display the pump run switch state for P-10A and P-10B.

3.7.4 Caustic (Sodium Hydroxide)

AC-2 controls the pH of the water in the third chamber of the Chemical Reaction Tank by controlling the dosing rate of the Caustic Pump P-11. The AC-2 pH set point is selected keep the chrome particles insoluble. The output signal from AC-2 is used as the dose rate set point for P-11.

The OIT shall display the pH of water in the third chamber of T-2. The pH display on the OIT will use units of S.U. (standard units). A pop-up display will include, the AC-2 tuning parameters, set point, and output signal.

3.8 Alarm Conditions

In the event of an alarm condition, the PLC shall log and display on the OIT the active alarm point. Except for Process Stop and loss of ferrous sulfate dosing, all process alarms allow the process to recover from the alarm condition and resume normal operations.
Selected components operated in hand mode will bypass all alarm interlocks except PROCESS STOP.

4.0 DESCRIPTION OF OPERATION

4.1 Overview of Normal Operation

To prepare the Chrome Treatment Facility to be powered up, all internal breakers and fuses shall be engaged. The mushroom head Process Stop button should be pulled out to the RUN position.

Turn the Main Disconnect switch to ON Position applying power to the PLC control panel. The power indicator light shall illuminate and the PLC and OIT shall boot.

Once the PLC and OIT have booted up, the system shall be in the OFF mode. All devices shall be de-energized, the Process Feed Pumps and the chemical metering pump(s) shall be OFF.
To keep the interceptor well pumps off line until the operator is ready to start the process, set the HS-IWF switch to off-line. The operator shall confirm that the position of manual operated valves and piping configuration are properly set for automatic process operation.

It is assumed that the level in T-1, T-2, T-3A, T-3B, C-3, T-5, and T-6 are close to their normal operating levels.

It is also assumed that the process operator has walked the process to configure all manually operated valves are in the correct position to enter into automatic operation.
It is further assumed that all analog set points, controller tuning constants, and alarm set points have been appropriately set (LC-1, FC-1, AC-2, LC-2, LC-5, and LI-9).
All process and dosing pumps have been set in the Auto position. All process mixers are in operation.
The treatment system can be placed in to automatic operation by placing HS-IWF to on-line.
The interceptor well pumps will begin operating in accordance with the local well controls.

Initial Process Settings:

TAG	EQUIPMENT	SWITCH OPTION	SELECT
Replacement Chrome Treatment Facility			
HS-IWF	Interceptor Well Field Well Pump Operating Permissive Input	GRANTED / **WITHDRAWN**	WITHDRAWN
HS-P1	Process Feed Pump Selector Switch	P-1A / P-1B	P-1A
HS-P1	Process Feed Pump	HAND/**OFF**/AUTO	AUTO
HS-M2A	Field mounted Mixer M-2A	On / Off	On
HS-M2B	Field mounted Mixer M-2B	On / Off	On
HS-P2	Clarifier Feed Pump Selector Switch	P-2A / P-2B	P-2A
HS-P2	Clarifier Feed Pump	HAND/**OFF**/AUTO	AUTO
HS-M3A	Field mounted Mixer M-3A	On / Off	On
HS-M3B	Field mounted Mixer M-3B	On / Off	On
HS-P5	Effluent Pump Selector Switch	P-5A / P-5B	P-5A
HS-P5	Effluent Pump	HAND/**OFF**/AUTO	AUTO
HS-P3	Clarifier Reject Pump Selector Switch	P-3A / P-3B	P-3A
HS-P3	Clarifier Reject Pump	HAND/**OFF**/AUTO	AUTO
HS-P4	Sludge Pump Selector Switch	P-4A / P-4B	P-4A
HS-P4	Sludge Pump	HAND/**OFF**/AUTO	AUTO
HS-P7A	Filtrate Pump P-7A	On / Off	Off
HS-P7B	Filtrate Pump P-7B	On / Off	Off
HS-P7C	Filtrate Pump P-7C	On / Off	Off
HS-M8	Lime Slurry Mixer	On / Off	On

TAG	EQUIPMENT	SWITCH OPTION	SELECT
HS-P8	Lime Slurry Pump Selector Switch	P-8A / P-8B	P-8A
HS-P8	Lime Slurry Pump	HAND/**OFF**/AUTO	AUTO
HS-10A	Polymer Pump	HAND/**OFF**/AUTO	AUTO
HS-10B	Polymer Pump	HAND/**OFF**/AUTO	AUTO
HS-P9	Ferrous Sulfate Pump	HAND/**OFF**/AUTO	AUTO
HS-P9	Ferrous Sulfate Pump Selector Switch	P-9A / P-9B	P-9A
HS-P11	Caustic Pump	HAND/**OFF**/AUTO	AUTO

5.0 I/O LIST

5.1 Digital Inputs

PARAMETER	DESCRIPTION
Process Stop	Process Stop
LSHH-T1	Equalization Tank Level, High-high
YI-P1A	P-1A Operating Status
YI-P1B	P-1B Operating Status
YI-M2A	M-2A Operating Status
YI-M2B	M-2B Operating Status
LSHH-T2	Chemical Reaction Tank Level, High-High
YI-P2A	P-2A Operating Status
YI-P2B	P-2B Operating Status
YI-M3A	M-3A Operating Status
YI-M3B	M-3B Operating Status
LSHH-T5	Effluent Tank Level, High-High
YI-P5A	P-5A Operating Status
YI-P5B	P-5B Operating Status
LSH-T7A	Dewatering Box Level, High
LSL-T7A	Dewatering Box Level, Low
LSH-T7B	Dewatering Box Level, High
LSL-T7B	Dewatering Box Level, Low
LSH-T7C	Dewatering Box Level, High
LSL-T7C	Dewatering Box Level, Low
YI-M8	M-8 Operating Status
TSH-T8	Lime Slurry Tank Temperature, High
FSL-8A	Lime Slurry flow, Low
FSL-8B	Lime Slurry flow, Low

PARAMETER	DESCRIPTION
YA-012	Safety Shower in Use
FSL-9A	Ferrous Sulfate flow, Low
FSL-9B	Ferrous Sulfate flow, Low

5.2 Digital Outputs

PARAMETER	DESCRIPTION
Process Stop	Process Stop Relay Output
HS-IWF	Interceptor Well Field Well Pump Operating Permissive Input
HS-P1A	Process Feed Pump
HS-P1B	Process Feed Pump
HS-P2A	Clarifier Feed Pump
HS-P2B	Clarifier Feed Pump
HS-P5A	Effluent Pump
HS-P5B	Effluent Pump
HS-P3A	Clarifier Reject Pump
HS-P3B	Clarifier Reject Pump
HS-P4A	Sludge Pump
HS-P4B	Sludge Pump
HS-P7A	Filtrate Pump P-7A
HS-P7B	Filtrate Pump P-7B
HS-P7C	Filtrate Pump P-7C
HS-P8A	Lime Slurry Pump
HS-P8B	Lime Slurry Pump
HS-10A	Polymer Pump
HS-10B	Polymer Pump

PARAMETER	DESCRIPTION
HS-P9A	Ferrous Sulfate Pump
HS-P9B	Ferrous Sulfate Pump
HS-P11	Caustic Pump
HS-P12	Ferrous Sulfate Transfer Pump
ZS-T6	FV-T6 Valve Position, To Sludge Conditioning Tank / To Flash Mix Tank

5.3 Analog Inputs

PARAMETER	DESCRIPTION
LI-1	Equalization Tank Level
FI-1	Process Feed Flow
AI-2	Chemical Reaction Tank, Chamber 3, Water pH
LI-2	Chemical Reaction Tank, Chamber 3, Tank Level
AI-C3	Clarified Water Turbidity
LI-5	Effluent Tank Level
LI-9	Ferrous Sulfate Tank Level

5.4 Analog Outputs

PARAMETER	DESCRIPTION
SC-P1A	Process Feed Pump Speed
SC-P1B	Process Feed Pump Speed
SC-P2A	Clarifier Feed Pump Speed
SC-P2B	Clarifier Feed Pump Speed
SC-P5A	Effluent Pump Speed
SC-P5B	Effluent Pump Speed
SC-8A	Lime Slurry Pump Speed
SC-8B	Lime Slurry Pump Speed
SC-9A	Ferrous Sulfate Pump Speed
SC-9B	Ferrous Sulfate Pump Speed

5.5 OIT Configured Operators and Parameters

PARAMETER	TYPE	DESCRIPTION
LSHH-1	T-1 Level Switch	Range: 0 – 15 feet; Initial Set Point: 13 ft.
LSH-1	T-1 Level Switch	Range: 0 – 15 feet; Initial Set Point: 12 ft.
LSL-1	T-1 Level Switch	Range: 0 – 15 feet; Initial Set Point: 4 ft.
LSLL-1	T-1 Level Switch	Range: 0 – 15 feet; Initial Set Point: 3 ft.
LSHH-2	T-2 Level Switch	Range: 0 – 15 feet; Initial Set Point: 13 ft.
LSH-2	T-2 Level Switch	Range: 0 – 15 feet; Initial Set Point: 12 ft.
LSL-2	T-2 Level Switch	Range: 0 – 15 feet; Initial Set Point: 4 ft.

PARAMETER	TYPE	DESCRIPTION
LSLL-2	T-2 Level Switch	Range: 0 – 15 feet; Initial Set Point: 3 ft.
LSHH-5	T-5 Level Switch	Range: 0 – 15 feet; Initial Set Point: 13 ft.
LSH-5	T-5 Level Switch	Range: 0 – 15 feet; Initial Set Point: 12 ft.
LSL-5	T-5 Level Switch	Range: 0 – 15 feet; Initial Set Point: 4 ft.
LSLL-5	T-5 Level Switch	Range: 0 – 15 feet; Initial Set Point: 3 ft.
LSHH-9	T-9 Level Switch	Range: 0 – 5 feet; Initial Set Point: 4 ft.
LSH-9	T-9 Level Switch	Range: 0 – 5 feet; Initial Set Point: 3 ft. – 6 in
LSL-9	T-9 Level Switch	Range: 0 – 5 feet; Initial Set Point: 1 ft.- 6 in
LSLL-9	T-9 Level Switch	Range: 0 – 5 feet; Initial Set Point: 1 ft.
LC-1 set point	Controller Setting	Range: 0 – 15 ft. Initial set point: 8 ft.
LC-1 Remote / Local	Controller Setting	Remote
LC-1 Proportional	Controller Setting	50
LC-1 Integral	Controller Setting	3
LC-1 Derivative	Controller Setting	0
LC-1 Auto / Manual	Controller Setting	Auto
LC-1 Manual, output set point	Controller Setting	50%
FC-1 set point	Controller Setting	Range: 0 – 400 GPM Initial set point: 100 GPM
FC-1 Remote / Local	Controller Setting	Remote

PARAMETER	TYPE	DESCRIPTION
FC-1 Proportional	Controller Setting	7
FC-1 Integral	Controller Setting	3
FC-1 Derivative	Controller Setting	0.5
FC-1 Auto / Manual	Controller Setting	Auto
FC-1 Manual, output set point	Controller Setting	25%
LC-2 set point	Controller Setting	Range: 0 – 15 ft. Initial set point: 8 ft.
LC-2 Remote / Local	Controller Setting	Remote
LC-2 Proportional	Controller Setting	50
LC-2 Integral	Controller Setting	3
LC-2 Derivative	Controller Setting	0
LC-2 Auto / Manual	Controller Setting	Auto
LC-2 Manual, output set point	Controller Setting	50%
LC-5 set point	Controller Setting	Range: 0 – 15 ft. Initial set point: 8 ft.
LC-5 Remote / Local	Controller Setting	Remote
LC-5 Proportional	Controller Setting	50
LC-5 Integral	Controller Setting	3
LC-5 Derivative	Controller Setting	0
LC-5 Auto / Manual	Controller Setting	Auto

PARAMETER	TYPE	DESCRIPTION
LC-5 Manual, output set point	Controller Setting	50%
SC-P1	Manual Speed Input	Variable
SC-P2	Manual Speed Input	Variable
SC-P5	Manual Speed Input	Variable
Ferrous Sulfate	D_f= Dose Factor	0 – 2 Set Point = 1.0
KC-3F	Frequency Timer	Timer based operation for P-220 Range: 0 – 1440 min Set Point: 720
KC-3D	Duration Timer	Timer based operation for P-220 Range: 0 – 1 sec Set Point: 30
KC-4F	Frequency Timer	Timer based operation for P-220 Range: 0 – 1440 min Set Point: 720
KC-4D	Duration Timer	Timer based operation for P-220 Range: 0 – 1 sec Set Point: 30
KC-6F	Frequency Timer	Timer based operation for P-220 Range: 0 – 1440 min Set Point: 720
KC-6D	Duration Timer	Timer based operation for P-220 Range: 0 – 1 sec Set Point: 30

5.6 Alarm Set Points

In the event of an alarm condition, the PLC shall log the alarm. The OIT will display the active alarm point. Except for Process Stop and loss of ferrous sulfate dosing, all process alarms allow the process to recover from the alarm condition and resume normal operations.

Equipment operated in hand mode will bypass all process logic and interlocks, except PROCESS STOP. Process switches that are configured to become an alarm, must continuously maintain its activated state during the on-delay time period before its associated alarm activates. The alarm condition shall be cleared after the alarm condition no longer exists.

Nuisance alarms, such as, low flow, are prevented by the PLC. For example, a low flow switch is not monitored by the PLC if its associated pump is off.

Following is a list of all system alarms and their set points. OIT configured alarms are operator adjustable.

PARAMETER	ALARM NAME	RANGE	DEFAULT VALUE	RESULT OF ALARM	TIME DELAY
LAHH-T1	Equalization Tank Level, High-High	Discrete Switch		Well Field Shutdown	10 sec.
LAHH-1	Equalization Tank Level, High	0 – 8 ft.	7 ft.	Well Field Shutdown	10 sec.
LALL-1	Equalization Tank Level, Low-Low	0 –8 ft.	1.0	Shut Down P-1	10 sec.
LAHH-2	Chemical Reaction Tank Level, High-High	0 – 8 ft.	6.5 ft.	P-1A/B Shutdown	10 sec.
LALL-2	Chemical Reaction Tank Level, Low-Low	0 –8 ft.	1.0	Shut Down P-2	10 sec.
LAHH-T5	Effluent Tank Level, High-High	Discrete Switch		Shut Down P-3	10 sec.
LAHH-5	Effluent Tank Level, High-High	0 – 8 ft.	6.5 ft.	Start P-3	10 sec.

PARAMETER	ALARM NAME	RANGE	DEFAULT VALUE	RESULT OF ALARM	TIME DELAY
LALL-5	Effluent Tank Level, Low-Low	0 –8 ft.	2 ft.	Shutdown P-5	10 sec.